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Howardite noble gases as indicators of asteroid surface processing.

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Introduction and Research Objective:

The HED (Howardite, Eucrite and Diogenite) group meteorites likely originate from the Asteroid 4 Vesta [1] - one of two asteroid targets of NASA's Dawn mission [2]. Whilst Howardites are polymict breccias of eucritic and diogenitic material that often contain "regolithic" petrological features, neither their exact regolithic nature nor their formation processes are well defined [3-4]. As the Solar Wind (SW) noble gas component is implanted onto surfaces of solar system bodies, noble gas analyses of Howardites provides a key indicator of regolithic origin. In addition to SW, previous work by [5] suggested that restricted Ni (300-1200 µg/g) and Al₂O₃ (8-9 wt%) contents may indicate an ancient well-mixed regolith. Our research combines petrological, compositional and noble gas analyses to help improve understanding of asteroid regolith formation processes, which will play an integral part in the interpretation of Dawn mission data.

Methodology:

Following compositional and petrological analyses [4,6], we developed a regolith grading scheme for our sample set of 30 Howardites and polymict Eucrites [4]. In order to test the regolith indicators suggested by [5], our 8 selected samples exhibited a range of Ni, Al₂O₃ contents and regolithic grades. Noble gas analyses were performed using furnace step-heating on our MAP 215-50 noble gas mass spectrometer.

Discussion of Results:

Of our 8 howardites, only 3 showed evidence of SW noble gases (e.g approaching ²⁰Ne/²²Ne ~ 13.75, ²¹Ne/²²Ne ~ 0.033 [7]). As these samples display low regolithic grades and a range of Ni and Al₂O₃ contents, so far we are unable to find any correlation between these indicators and "regolithic" origin. These results have a number of implications for both Howardite and Vesta formation, and may suggest complex surface stratigraphies and surface-gardening processes.

- [1] Drake M.J. (2001) *MAPS* 36:501-513. [2] Rayman, M.D. *et al.* (2006) *Acta Astronautica* 58:605-616. [3] Mittlefehldt, D.W. *et al.* (1998) *Rev. Min.* 36: 4.1-4.195. [4] Cartwright, J.A. *et al.* (2011) *LPSC XLII* (abs. # 2655). [5] Warren, P.H. *et al.* (2009) *GCA* 73:5918-5943. [6] Mittlefehldt, D.W. *et al.* (2010) *LPSC XLI* (abs. #2655). [7] Grimberg, A. *et al.* (2008) *GCA* 72:626-645.